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Measuring the Value of Renewable Resources: The Case of Wetlands*

A paper based on the "Wetlands Are Not Wastelands" project and pilot studies with the objective of developing better procedures and methods for indicating the true value of renewable resources to decision-makers.

by

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Introduction

The implementation of the concept of sustainable development, as defined by the Brundtland World Commission on Environment and Development, (1987) and as endorsed by the Task Force on Environment and Economy report to the Canadian Council of Resource and Environment Ministers (1987) is predicated upon improvement to the decision process at all levels. Local and regional planners and decision-makers are in effect the front lines of environmental decision making, but to date they lack the needed tools and methods to permit them to readily underatand and internalize the full range of environmental values into their decisions.

Current methods of evaluating many resources inadequately portray their true environmental and economic value to society based on the functions they support. (deGroot, 1986). For example, this is particularly true of wetlands, which, when threatened with conversion to other uses or with degradation, have been virtually impossible to adequately value using the most common current methods of socio-economic evaluation. Nevertheless, there is increasing recognition by various governments and agencies of the value of wetlands functions (e.g., water storage, sediment retention, nutrient recycling, habitat, biomass energy) to society for wildlife and nature conservation, active and passive recreation, commercial plant and animal production, extraction and risk reduction, among others.

Many of the functions of wetland environments are common property functions, even though rights to certain locations or functions may be privately held and managed. Part of the problem for evaluators is that they are having to compare values for marketed aspects of the resource (access, the right to fill and farm, the right to drain) with common property attributes which may be ill-defined and whose current and potential users are frequently unknown. Yet in many cases, these common property functions, and the values they

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serve are of considerable significance, and may be the source of benefits at a regional or larger scale.

In response to the increasing public concern for the maintenance of the environment and as a way to address operational problems in defining and defending the values of specific environments (particularly wetlands threatened with development), an initiative by Environment Canada and Wildlife Habitat Canada, the "Wetlands Are Not Wastelands" project, has been undertaken. The objective of this project is to develop and evaluate a sequence of screening procedures and evaluation methodologies which may more adequately portray the full range of values of wetland resources.
Specifically, the purposes of the project are to:

1. Adapt existing methods and/or establish new methods for better evaluating the full socio-economic and environmental values of wetlands to society;

2. Undertake pilot studies to test the selected methods vis-a-vis alternate uses in order to demonstrate the specific values of selected Canadian wetlands;

3. Produce a Reference Guide to be utilized by resource planners and decision-makers and others as a set of desired screening procedures and methods for the evaluation of wetland areas in relation to proposed changes; and

4. Ensure the initiation of an effective on-going consultative process with a wide spectrum of involved groups regarding methods for the evaluation of natural resources, with the ultimate objective of improving the application of evaluation procedures to resource management and planning decisions in all renewable resource sectors in Canada.

Review of Selected Methods

Initially a list of potential approaches to the evaluation of wetlands was developed, based on a workshop focusing on alternate methods of evaluating renewable resources (Manning and Cox, 1986). The methods include:

1. a **multiple function approach** synthesizing a broader range of societal goals and objectives for the use of wetland functions than those generally encompassed by the term "economic", which potentially could be employed as a screening technique;

2. a **social benefit/cost approach** involving opportunity cost concepts to be applied to measurable wetland values and to the proposed alternate use; and

3. techniques to measure the **willingness-to-pay** for wetland benefits based on contingent evaluation methods which can provide estimates to the social benefit/cost approach.

The **multiple function approach** entails screening a particular resource alienation proposal against a series of specific standards or benchmarks reflecting the range of applicable societal goals and objectives associated with or served by wetlands (cf. Bond et al., 1988). This necessitates the identification of which social values are served by the functioning of wetland areas, and, of these, which are threatened by a given development proposal. A set of criteria, both quantitative (for example, recognized water quality standards) and qualitative (for example, general objectives related to conservation of habitat diversity) are identified from existing legislated and stated governmental goals and objectives, as well as from scientific principles. This approach both encourages the evaluator to consider the full range of objectives which may be associated with the functions derived from the wetland, and identified to policy-makers specific gaps where guidelines, standards, thresholds etc. are missing.

Projects failing to satisfy one or more of the existing standards can in some cases be eliminated in initial screening, particularly if there is a legislated limit (e.g. habitat for endangered species) which acts as a legal cutoff. But for most environments specific legislated limits may be missing. Most wetland environments will therefore be evaluated in light of their impact on the range of identified societal values. Because several different criteria are used to evaluate alienations, the analyst and the decision-maker are faced with a visible accounting of the cost of any given action through the explicit identification of which social values may be jeopardized by the proposal. There seems to be advantage to not quantifying or establishing a hidden weighting system which produces a yes/no response: the visible accounting may serve to better make decision-makers publicly accountable for the subjective decisions they make.

The basis of evaluating the **opportunity costs of development** is the derivation of monetary values for the entire range of benefits derived from a wetland. Therefore, the initial concern in applying the method is in ascertaining the presence of any given wetland function providing benefit within a social benefit/cost framework. In some cases simple inventory techniques and observation can confirm a wetland's value (e.g., through surveys of hunting or biological inventories of endangered species). In other circumstances such data are fugitive or may not be feasible to obtain for monetary, time or technical reasons. Prior studies have illustrated a variety of means by which to perform the economic analyses of wetland values.

The **contingent evaluation method** for estimating willingness-to-pay is reasonably well established (Mitchell and Carson, 1989). A more or less hypothetical (contingency) market is established for non-market goods or services. This normally involves reliance on the collection of data directly from individuals to assess personal estimates of their valuation (for example, of a wetland area or of particular products or services which they may obtain from it). In some circumstances this valuation can then be used as an input to

the estimation of opportunity costs within a social benefit/cost framework.

Pilot Study Areas

The three approaches were applied in four pilot studies:
Greenock Swamp in Ontario (Bardecki, 1988),
Cowichan Estuary in British Columbia (Ferguson et al., 1989),
Minudie Dykelands in Nova Scotia (Stokoe et al., 1989), and
Prairie Pothole region in Saskatchewan (Young et al., 1990).
The results have been reviewed by the various project steering committees and in a number of articles and review studies. (e.g. Bardecki, 1989).

In addition to the case studies, in January 1990 a Workshop of 20 experts in resource economics, wetlands science and land use planning from Canada, the U.S. and the Netherlands was held in Ottawa to review the progress of the project; critically evaluate and analyze the scientific validity and practical applicability of the three methods; and to provide guidance concerning the development of the Reference Guide.

The purpose of this paper is to review the progress of the project, to document the evolution of concepts and approaches due to the workshops and the completion of the four pilot studies and to suggest the nature of future initiatives. Specifically, four issues are addressed:

1. Based on the results of the case studies, questions relating to the potential role and application of appropriate techniques and the choice of an evaluative framework for future development of the project are identified;

2. The results of the Workshop evaluating the results of the four case studies are reviewed, particularly with respect to their bearing on the project's progress and the relationships between the tested methodologies and other promising avenues revealed during the process of the case studies;

3. The development and thrust (structure, content and potential use) of the next phase - the development of the Reference Guide are discussed; and

4. Future directions and applications of the findings of the project are outlined.

Issues Arising From the Case Studies

The four case studies selected for the pilots represent a variety of marshland environments and quite different development proposals or threats. The studies spanned Canada from coast to coast, and covered a representative range of typical wetland conversion

questions. The four cases are briefly described below:

A. Greenock Swamp is a large treed wetland in the agricultural region of southern Ontario. It is being gradually drained and filled through agricultural encroachment.

B. Minudie is part of a large coastal wetland system in Nova Scotia(the Tantramar Marshes), drained in the 18th century and now the focus of potential restoration works.

C. Cowichan Estuary on Vancouver Island is a rich estuary with salmon habitat, migratory bird staging and considerable recreational use. It has some current logging industry use and is the site of several major industrial proposals.

D. The Prairie potholes of Saskatchewan (two sites were examined, one in the dryland area, the other in the wetter parkland region)are a large region where agricultural drainage and filling has steadily encroached, with significant reductions.

During 1988-90 field level pilot studies were carried out by teams in each of these study areas, based upon the methods identified above. The four case studies attempted to examine, and to an extent emulate the conditions of information availability that would exist for a local planner. All four studies were successfully completed, with mixed results. In some cases, information needed was simply unavailable, or required detailed field level collection. In other cases, quite complete application of some of the methods was achieved. As a result, the pilot studies represent a reasonable representation of the methods' applications in a variety of circumstances. A number of questions arose which were carried to the next phase; the 1990 Workshop. Several of these dealt with specific applications of the three methods and with particular operational concerns relating to their field application in the particular instance; however, the more fundamental questions included:

1. Can, and how, might the various methods be integrated coherently and systematically? Can all be accommodated within a single framework? Is there a role for a specific approach to consolidate the objectives in a efficient manner?

2. Is there a need to establish a hierarchy of procedures in order to streamline the analysis? Specifically, how might the cost, time and data efficiency, and precision of the alternate methods be most practically used in achieving a useful assessment of wetland values? For example, might there be consideration of a screening process prior to more intensive economic appraisals of wetland's values?

3. Should, or can, the methods be standardized? As part of this, given the rather broad application of many policies, plans and programs affecting wetlands as well as the potentially ubiquitous

application of many scientific principles, might it be useful to provide a standardized guide to existing objectives even at a regional level?

4. To what degree does the approach fit within the standard practices of planning? Is it possible to modify it in some manner to make it more consistent with current planning processes, while building on the sustainable development principle of full accounting for environmental values?

5. By what means can the presence of specific functions and benefits for a given wetland be verified? Techniques are available (e.g., wetland evaluation systems, habitat of indicator species, secondary sources and expert judgement). What is their role? How can the magnitude of the functions be established? Are means available (perhaps from the practice of environmental impact assessment) for predicting the impact of an alienation on those functions and assessing the undertaking's viability?

These and other issues were dealt with in the two-day Workshop convened in Ottawa in January 1990.

Workshop Results

The Ottawa Workshop sessions included wide-ranging discussion of the approach, methodologies and applications. The case studies were reviewed; the methods were critically evaluated and analyzed from the point of view of their scientific and pragmatic soundness; and guidance was provided concerning the development of means to support better decisions in the form of a Reference Guide.

Limitations to Each of the Methods

It was evident from the case studies that each of the methods had specific limitations. These were not universal -- the utility of the methods differed in particular circumstances. For example, the Workshop recognized the many conceptual problems with contingent evaluation. The method is often misused and misunderstood, therefore best restricted for projects involving substantial non-market benefits and where specific expertise is available. Nonetheless, in at least one of the case studies (Cowichan Estuary), contingent evaluation provided a comprehensive and constructive measure of wetland values. It also provided one of the few data sources for non-market values associated with the dispersed Prairie wetlands. Nevertheless, application of \relatively sophisticated techniques like contingency evaluation will not be easy in the field for untrained personnel. Similarly, several of the study teams had difficulties in identifying the specific points of reference for the multiple objective approach, and identified many gaps which might require legislation or policy development if they are to be useful as differentiating factors. From the difficulties encountered in some of the study areas, it is clear that the difficulties/concerns of each technique need be addressed in the Reference Guide and the appropriate circumstances for their use be clarified.

Relating Functions to Benefits

One of the key elements highlighted in the Workshop discussion was the acknowledgment of the need to recognize the relationships between the functions of wetlands (i.e., physical and biological processes taking place) which may be ascertained, the recognizable benefits to society which these provide, and the socio-economic values which may be placed on these benefits. There is a necessity to keep separate accounts as data availability, analytical sophistication and information content differ. For example, in many cases only specific and limited data can be obtained and the relationship of this information to an comprehensive appraisal of the wetland's value is problematic. And yet, even limited data may be sufficient to resolve many planning issues.

Linking The Approaches

Given these considerations, the Workshop suggested that the screening and evaluation procedure might be considered as a form of triage with a scoping of the investigation involving the possibility of a cut-off of the analysis where there is sufficient information to make a decision. The analysis and evaluation of the wetlands would, for example, only proceed to a benefit-cost framework if was not possible to easily come to a decision at the end of the initial screening and link of identified functions to the goals they were found to serve. Evaluation would only proceed to the final and most sophisticated, time-consuming and expensive stage of measurement, involving the estimation of values for non-marketed functions, if there was continuing uncertainty as to the value of both the wetland benefits and those of the alternative use. This has been accepted as the major structure for the Reference Guide. All three methods tested in the pilot studies -- multiple function analysis, social benefit/cost analysis (opportunity cost) and contingent evaluation -- would become part of one sequenced screening and evaluation approach.

Effects of Incremental Impacts

The focal issue for the Guide was recognized as being that of assessing the effect of the incremental impacts of developments which potentially involve the alienation of all or a portion of a wetland's functions (i.e., of deriving a marginal value for any loss of wetland benefits). This is in keeping with the paradigm of sustainable development. Specific thresholds concerning required levels of wetlands or of specific benefits derived from wetlands may have to be established and verified.

Following the Workshop an initial draft of the Reference Guide (Table 1) has been prepared by one of the authors (Bond). It is being circulated to all Workshop participants for comment and revision before work on the Reference Guide proceeds.

Towards a Reference Guide

The next stage in the project is the preparation of the proposed Reference Guide. A general outline for the Guide has been defined (Table 1) and work is under way to elaborate this outline into a working document. The purpose of the Guide is to establish desired procedures for the evaluation of wetland areas in support of planning and management. In general, the Guide may be thought of as a set of guidelines to provide advice and establish approaches which lead to a particular technical requirement for the evaluation. It is designed to lead individuals through a logical process to evaluate the options with respect to a decision which may involve the modification, conversion, loss, or gain of wetland areas. It is recognized that the proposed procedures need be quite specific so as to effectively guide non-experts through the process, but room needs be allowed for sensitivity analyses given limitations of data and procedure.

Initially the Guide is to provide a broad "triage" screening process whereby inherently manifest decisions may be resolved -- the screening based in part on a multidimensional recognition of such factors as the scarcity, subsistence dependance, biological productivity, and hydrological functioning of the wetland area, habitat capability for indicator species and the cumulative loss of wetlands in a region. Key sites may be "red-flagged" for protection; in other situations, development may be permitted given limited potential for inappropriate impacts. Certain proposed projects with potential impacts on wetland areas may be identified as unacceptable for reasons of internal economic non-viability or due to the acceptability of alternate non-wetland sites or because of the high capability or protected status of the wetlands at issue. Those projects with minimal potential for adverse impacts could be accepted (with appropriate mitigation). Finally, certain projects, particularly those affecting moderate capability wetlands, would remain in the gray area, necessitating more detailed investigation; at his stage the other methods of evaluation would come into play.

The second stage of the Guide provides for the inventory and evaluation of the entire range of benefits associated with wetland areas, recognizing the existing policy/planning context -- local, regional, provincial and federal. The multiple function analysis not only provides for a sensitization by planners and decision-makers to the specific benefits of wetlands but may serve as a basis for negotiation. A "spreadsheet" approach can force the decision-maker to see the range and complexity of values provided by wetlands and recognize the nature and scale of trade-offs involved. Faced with a development proposal, benefits foregone and value sacrificed as well as the distributional aspects of each wetland benefit, be it involving water quality, habitat, endangered

species, recreation, scientific use, etc., may be demonstrated. In its current conception, no overall quantitative comparison of benefits and costs would occur at this stage- instead the range of values and trade-offs would be visible for subjective comparison.

If the decision about wetland use and development remains uncertain, requiring more information and analysis at this point, the investigation may proceed to the third stage where the evaluation occurs within a social benefit/cost framework using an appropriate range of economic-based concepts (i.e., opportunity cost), tools and techniques to fully incorporate the range of benefits and values identified at earlier stage. This involves the full application of opportunity cost analysis including a critical evaluation of the development proposal and an internal benefit/cost analysis. It is recognized that local, regional and federal perspectives may differ from a proprietary analysis -- there is a need for a broader perspective.

One would expect that the third stage of the Guide would usually be employed only in the case of substantial undertakings and would be handled by government departments, planning agencies, or firms with sufficient resources and expertise to satisfactorily undertake such an analysis.

The Guide also would also provide users with guidance regarding the appropriate application of particular techniques and methods such as estimates of willingness-to-pay by contingent evaluation methods, travel cost, etc. including identification of potential pitfalls in their use. For example, contingent evaluation techniques might be used to evaluate specific wetland functions, such as capacity to support current or potential recreational uses, to contribute to the estimation of opportunity costs of development within a social benefit/cost framework.

This tiered approach is designed to sensitize planners and decision-makers to the full range of functions of specific environments and to the range of values(both private and common) which depend upon these functions. A continuing challenge is to clearly define the productivity response of these values to changes in the environmental base, and to identify thresholds where the ability to support specific values disappear.

Future Initiatives

It is anticipated that the first draft of the Reference Guide will be completed in early 1991. It will be subject to peer review and will be vetted through various users (including planners, academics and government personnel). The outline that exists still leaves a number of questions unanswered, particularly regarding the details of the specific implementation of the procedures during the second and third stages. For example, given the anticipated level of expertise of those by whom the methods may be employed, the generally disparate expertise needed for a full understanding of

the situation, and the often limited time constraints available for review, consideration has to be given to the role of a workshop concept as a valuable means of focussing and directing the appraisal procedures, particularly at the second stage. In addition, a number of technical questions still need be addressed, including questions of access to needed information at the local level, the need for support systems for local planners, and the establishment of the legal and policy frameworks in some key areas which will allow the initial screening to proceed with maximum effect. In particular, many common property values are not explicitly reflected in the legislative and policy frameworks of Canadian governments. Many significant functions, such as maintenance of genetic diversity, ecosystem variety, toxzuc buffering or even aquifer recharge functions are not recognized, and points of reference for valuation can be found at best in the scientific literature. It will not be realistic to expect decision makers to incorporate values if the necessary framework to support them does not exist. These gaps must be targeted and remedied by the policy process if thorough evaluations are to be practical. This project has been of considerable assistance in identifying some of these and several will be remedied once a Federal Policy on Wetlands, currently in development is in place. Others will be remedied principally through the provision of better environmental information in a format and scale most useful to the evaluators and decison-makers.

Given a measure of success, it is anticipated that the Guide developed for wetlands may act as a model for the development of methods to reflect the true value to society of other renewable resources.

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Table 1

Draft Reference Guide Outline

A - Purpose: primary as an analytical tool for wetland areas

B - Who Should Use It: public agencies, industry, developers, NGOs

C - Introduction: rationale for wetland protection; functions of wetlands and their value to society

D - Evaluation Method: a three-stage, tiered decision process

1. Stage 1

Context - description of wetland and proposed development
- factors which need be addressed

Alternatives - are there reasonable alternatives in terms of sites, type and scale of development to the proposed development on a wetland area
- specify alternative scenarios

Initial Screening

Economic Screening
- internal benefit/cost ratio of development (without subsidies)
- net opportunity cost of alternate sites

Biophysical Screening
- identification of general wetland capability (high, moderate, low) using existing inventory screening processes (Ontario wetland evaluation, Golet, etc.)
- biophysical capability of wetland for proposed alternate use
- recognize limitations of screening methods and identify other potential wetland benefits
- issue of cumulative loss (has a threshold been reached?)

First Decision Point
- "red-flag" highly valued or protected wetlands
- moderate capability wetlands warrant continuing to Second Stage
- for low capability wetlands, continue evaluation only if there is doubt about the value and extent of certain wetland benefits or if there is a question re cumulative loss or regional thresholds

2. Second Stage

Multiple Function Evaluation Process

- quick inventory and evaluation of the entire range of current and potential wetland benefits using appropriate methods (e.g., WET (Admaus et al., 1987)) within the context of the quantitative and qualitative criteria identified from existing legislated and stated governmental goals and objectives, as well as from scientific principles
- guidelines re data sources, indicators, appropriate data
- provide summary of magnitude and importance of functions served by wetland in a local, regional and national context

Second Decision Point

- development denied (with rationale)
- evaluation continued -- more information required
- development approved (with mitigation)

3. Third Stage

Social Benefit/Cost Evaluation Framework

Specific Guidelines

- account for all costs and all benefits of proceeding or not proceeding
- clarify and identify the point of view of the analysis -- global, national, regional, local, proprietary
- sensitivity analysis incorporated

Possible Methods and Their Strengths and Limits of Application

- replacement cost framework
- contingent evaluation
- transport cost, Hotelling
- replacement cost
- shadow pricing
- other

Third Decision Point

- development denied
- development approved with modification or mitigation
- development approved

F - Conclusions

G - Appendices

- list of policies, legislation and guidelines pertaining to wetlands
- list of provincial and federal contacts
- sources of data
- summaries of case studies
- selected readings
- glossary

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